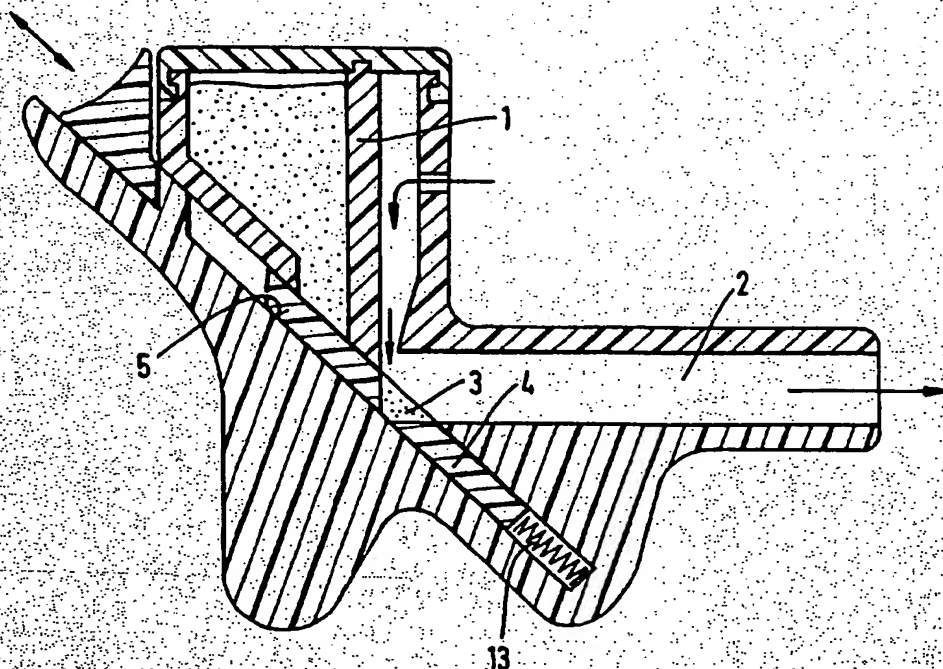


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(54) Title: POWDER INHALER**(57) Abstract**

This device is intended for the dispensing of a powdered medication by inhalation. The device includes a powder container (1), an air channel (2), and a metering strip (4) equipped with a dosing recess (3). The metering strip (4) can be moved along a flat surface (5) from a filling position, in which the dosing recess (3) is filled with powder coming from the container (1), to an inhalation position, in which the dosing recess (3) is in the air channel (2).

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Powder inhaler

The invention relates to a device for dispensing of a powdered drug preparation by inhalation. The device is in particular a multiple-dose device without propellant gas, equipped with a metering means which dispenses doses from a powder container. A device such as this is usable, for example, in the treatment of asthma.

The administering of powdered drug preparation by inhalation from an inhaler is commonly known. Multiple-dose type powder inhalers comprising a powder container and a metering member which measures and dispenses a unit dose are also known, for example from patent publications GB 2165159, EP 79478, and EP 166294. In these devices, a series of dosing recesses are notched into the surface of a cylindrical metering member, and the said member is disposed in a chamber of precisely the same shape. When the metering member is rotated, the dosing recesses in turn will move first to a position in alignment with the powder container for being filled and thereafter to a position in alignment with the inhalation channel, whereupon a unit dose will fall by gravity from the dosing recess into the inhalation channel. Thereafter the dose of medication is inhaled from the inhalation channel. These devices have the drawback that they make overdosing of the medication possible by allowing the dispensing of a plurality of doses in succession into the inhalation channel, whereby a multiple dose may be drawn by one inhalation.

Inhalation devices having a metering plate movable between filling and dispensing position are described e.g. in patent publications WO 92/10229, US 5113855, US 2587215, EP 546996, WO 94/04210 and US 5161524. However, also these devices suffers from a drawback that they make overdosing possible by allowing the dispensing of a plurality of doses into the inhalation channel.

Attempts have been made to solve this problem by using dispensing systems in which the dosing recess will not be emptied into the inhalation channel by gravity but, instead, the dose of medication is inhaled directly from the dosing recess, such recesses having been notched into the surface of a metering member having the shape of a cylinder, a cone or a truncated cone, as disclosed in patent publications WO 92/00771 and WO 92/09322. Also in these devices, a metering member having the shape of a cylinder, a cone or a truncated cone is disposed in a chamber having precisely the same shape. When the metering member is rotated, the dosing recesses will move first to a position in alignment with the flow container for filling, and then to the inhalation channel, which is shaped so that the dosing recess will be emptied under the effect of the air flow being inhaled, and thereafter, having rotated through a full 360°, back to a position in alignment with the flow container. The lower surface of the chamber wall may also have an emptying aperture from which any powdered medication possibly left in the dosing recess will fall out during the said rotation.

In the rotating dispensing devices described above, the distance from the filling position to the inhalation position is less than 90° of a circle arc. Since the metering member is, for purposes of metering precision, disposed within a chamber of the same shape, and since it has to be rotated through 360°, of which at least 270° are useless for the actual function of the inhaler, in these devices particles will inevitably fall onto the slide surface between the metering member and the chamber. Thereby the rotation of the highly sensitive metering member will be disturbed and may even be completely obstructed. The metering member jamming in the chamber will hinder the functioning of the whole device. Vigorous shaking or tapping will only increase the jamming, as more powder flows into the gap between the chamber and the metering member.

The invention relates to a powder inhaler which has the following properties:

- 1) it can be operated with one hand;
- 2) the dosage may be easily set for different powder quantities;
- 3) the device will dispense only one dose at a time;
- 4) the surfaces rubbing against each other are small, whereby the risk of their jamming is reduced;
- 5) the track of movement on which the surfaces will rub against each other is small;
- 6) if desired, any remnants of powder left on the rubbing surfaces and in the inhalation channel can be removed automatically by gravity, without any further steps to be taken or tracks of movement.

The principle of the device according to the invention is illustrated below by way of example, with reference to Figures 1-4.

The powder inhaler according to the invention includes a powder container (1), an air channel (2) through which air is drawn via a mouthpiece, and a metering strip (4) equipped with a dosing recess (3), the strip being disposed on a flat surface (5) and being movable in its longitudinal direction along the flat surface between a first position, in which the dosing recess is filled with powder coming from the container, and a second position, in which the filled dosing recess is brought into the air channel, wherein while the metering strip is in a second position the powder is maintained in the recess by the support of the recess bottom before the inhalation and the air channel is adapted to introduce the air flow into the bottom of the dosing recess during inhalation whereby the powder is released directly from the dosing recess. In the metering strip the metering recess preferably extends through the metering strip, in which case, in an inhaler ready for use the said flat surface constitutes the bottom of the metering recess. Such a metering recess may, for example, simply be drilled through the metering strip.

For the removal of any powder possibly left between the surfaces

rubbing against each other, the inhaler may additionally have an aperture for remnants. The aperture for remnants may be constructed so that, when moving along the flat surface between the first and the second positions, the metering strip will travel over the aperture (6) for remnants, at which time any powder possibly remaining between the metering strip and the flat surface will, in normal use of the device, automatically fall via the aperture for remnants into a chamber for remnants.

The movement of the metering strip between the first and the second positions can be implemented in a number of ways. Figure 1 depicts an embodiment in which there is, locked to a moving outer casing (7), a lever member (8) which is attached eccentrically to the body and in which articulations (9) and (10) can be effected, for example, by thinning the elastic plastic in the area of the articulation. The metering strip (4) and the lever member may, when so desired, be made as one integral piece. The figure shows how the metering recess is shifted from the filling position to the inhalation position by a depression of the outer casing. When the depressing of the outer casing is discontinued, a return spring (11) will return the casing and the whole mechanism to the initial position. The return spring may be disposed as shown in the figure, or it may be disposed directly in connection with the lever member.

The moving of the metering strip between the two positions may also be implemented in the manner depicted in Figure 2. This mechanism is straight and simple. By a depression of a button (12) in the back wall of the inhaler, the metering strip (4) will be moved to the inhalation position. In this case the depressible outer casing is unnecessary, and the powder container (1) may as a construction be detachable from the body of the device. In such a refill embodiment the powder container may be attachable to the body, for example, by a snap-fit or by means of threading. The inhaler is thus composed of a body and a powder container attachable thereto. A filled powder container closed with a cap may thus be an independent sales item, which the user can himself connect to the body part. In this case the

size of the powder container can be varied widely. Furthermore, problems of shelf life will be reduced, since the combining of the powder container and the metering part will take place only in connection with the device being taken into use.

In the figures referred to above, the flat surface has been depicted as being horizontal when the device is in the normal position for use. It is, however, to be noted that the flat surface (5) need not necessarily be horizontal; the flat surface may also be constructed, for example, so as to be downwardly inclined, in which case also the metering sheet will move slantedly downwards in the normal position for use. This will facilitate the removal of powder from between the flat surface (5) and the metering strip (4).

Many users are accustomed to using conventional aerosol inhalers, which are actuated by depressing from the top. The best aspects of the embodiments depicted in Figures 1 and 2 can be combined, whereby a refill inhaler is obtained which is operated in the manner of an aerosol by depressing from the top. Such an embodiment is depicted in Figure 3. There is no depressible outer casing but, instead, an attachable powder container (1) which is depressed like an aerosol container. The flat surface (5) is constructed so that it is not fixed but, for example, spring-actuated. A depression of the container will cause the lever member (8) to move the metering sheet (4) to the inhalation position. On the other hand, the inhaler of Figure 2 can be modified so as to have an outer casing, in which case the outer surface of the push button is bevelled so that, when depressed, the outer casing will cover the push button and push it in. In this case the outer casing must have its own return spring.

Figure 4 depicts an example of an inhaler according to the invention, in which the metering strip (4) and the flat surface (5) are downwardly inclined. This simple inhaler is assembled by snap-fitting the upper and lower pieces together, for example, by means of a snap tabs, after the spring (13) and the metering

strip (4) have been placed in their slot. The inhaler may be disposable, in which case the container (1) is filled at the factory and is closed with a cap from above. The inhaler may also be of the refill type, in which case, for example, a drug-containing cylinder having a bottom is installed in the powder container while the device is upside down. In this case the inhaler cap can thus be repeatedly opened and closed. The powder container of the inhaler may, of course, also consist of only the said drug-containing cylinder, which is in this case attached to the body of the inhaler by means of, for example, threading.

Claims

1. A powder inhaler comprising a powder container (1), an air channel (2) through which air is drawn via a mouthpiece, and a metering strip (4) equipped with a dosing recess (3), the strip being disposed on a flat surface (5) and being movable in its longitudinal direction along the flat surface between a first position, in which the dosing recess is filled with powder coming from the container, and a second position, in which the filled dosing recess is brought into the air channel **characterized** in that while the metering strip is in a second position the powder is maintained in the recess by the support of the recess bottom before the inhalation and the air channel is adapted to introduce the air flow into the bottom of the dosing recess during inhalation whereby the powder is released directly from the dosing recess.
2. A device according to Claim 1, **characterized** in that the dosing recess extends through the metering strip, in which case the said flat surface will constitute the bottom of the dosing recess.
3. A device according to Claim 1 or 2, **characterized** in that, when moving between the filling and the inhalation positions, the metering strip will travel over an aperture (6) for remnants, at which time any powder possibly remaining between the metering strip and the flat surface will fall out through the aperture.
4. A device according to any of the above claims, **characterized** in that the device has a return mechanism which will automatically return the metering strip from the inhalation position to the filling position.
5. A device according to any of the above claims, **characterized** in that the device has a depressible outer casing (7) and a lever member (8) locked thereto.

6. A device according to any of Claims 1-4, **characterized** in that the powder container (1) is detachable from the device.

7. A device according to Claim 6, **characterized** in that the powder container (1) is depressible.

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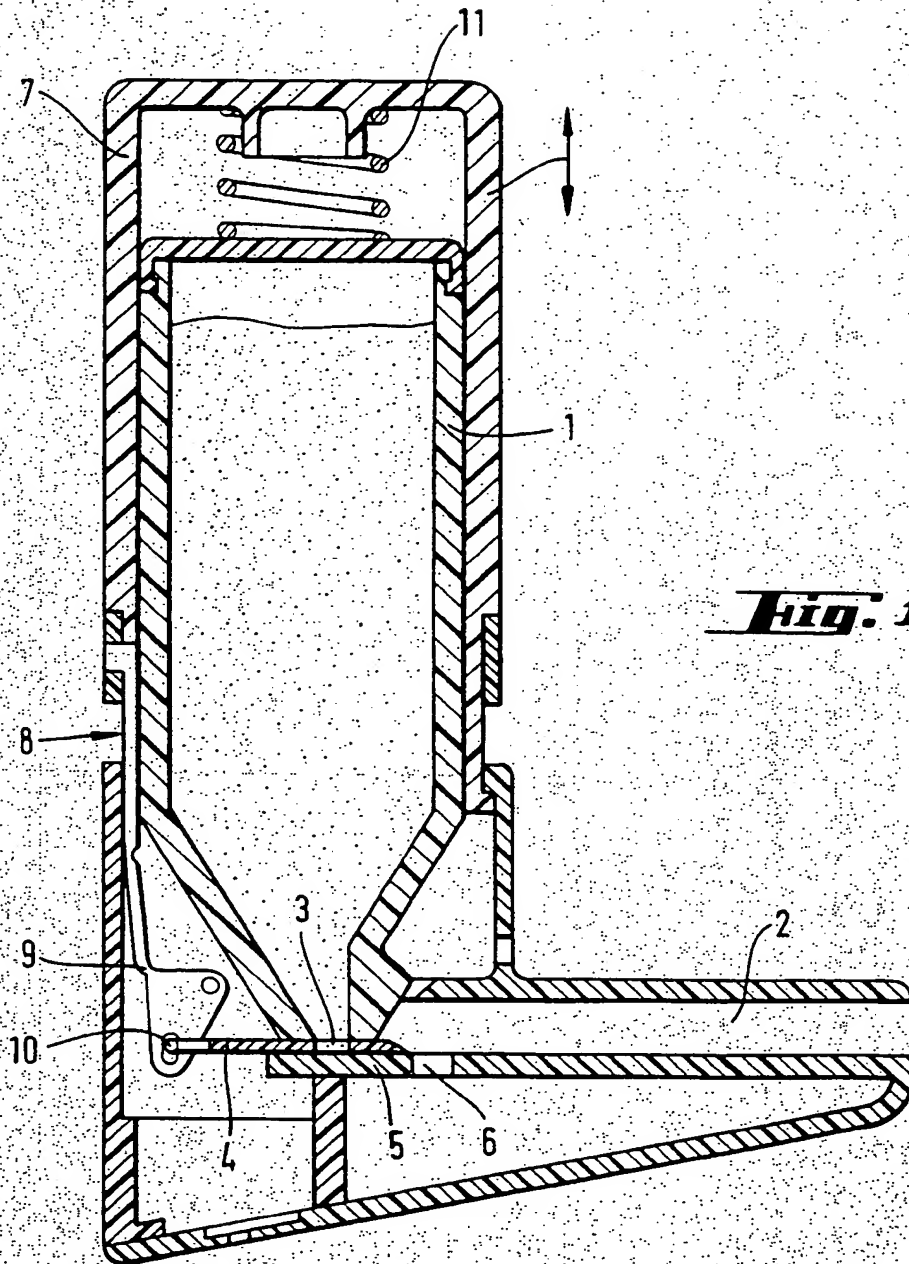
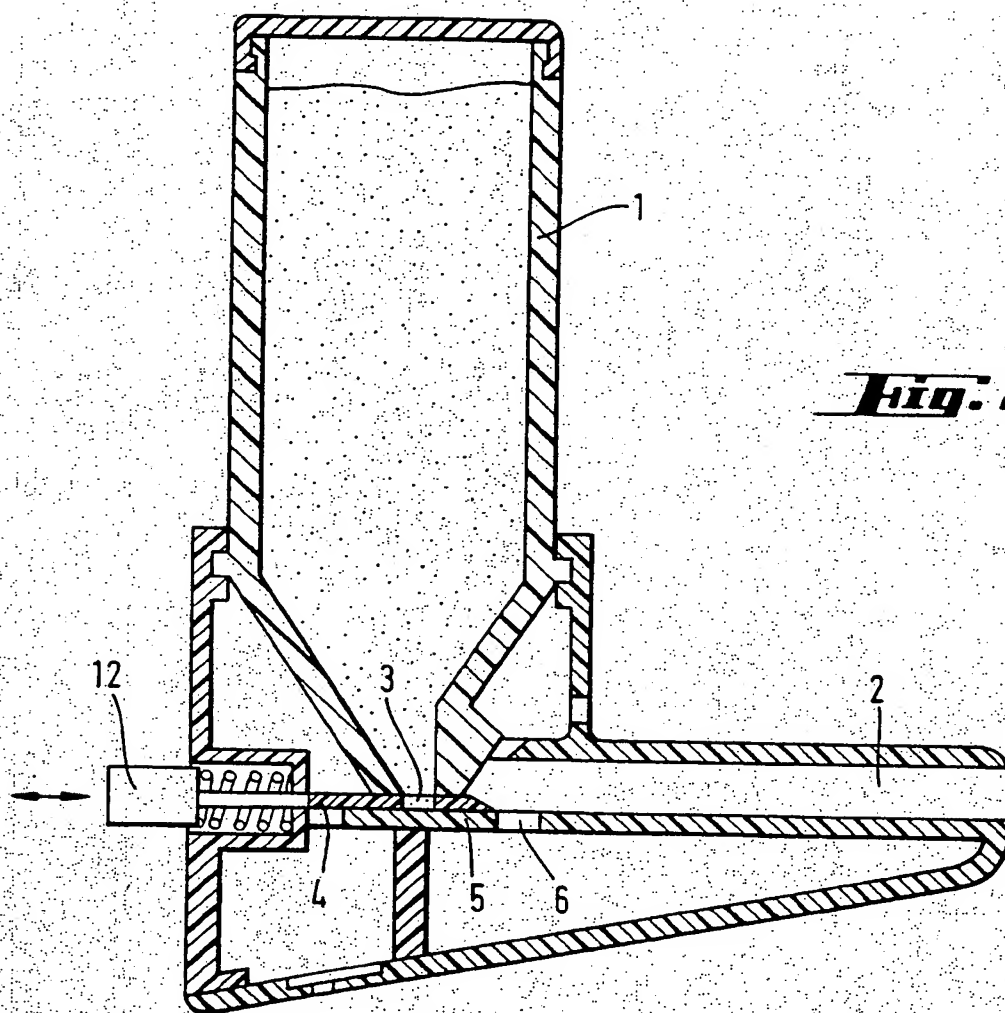


Fig. 1



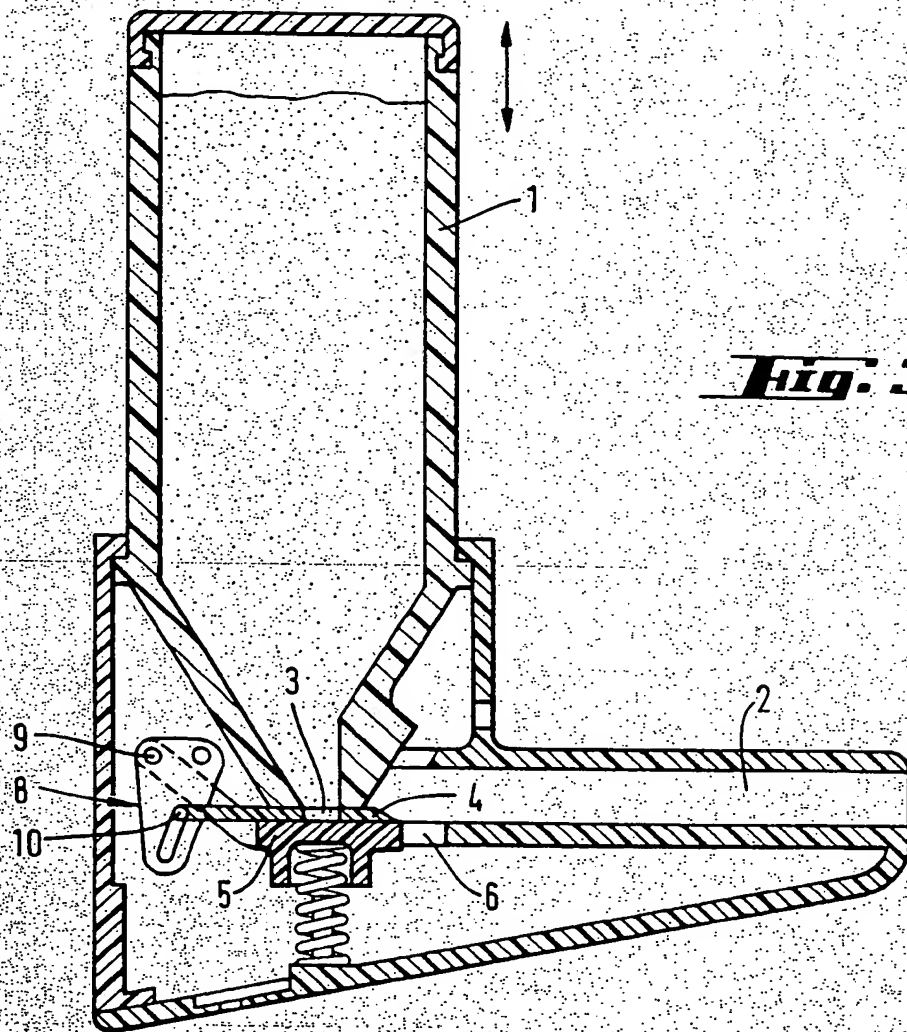


Fig. 3

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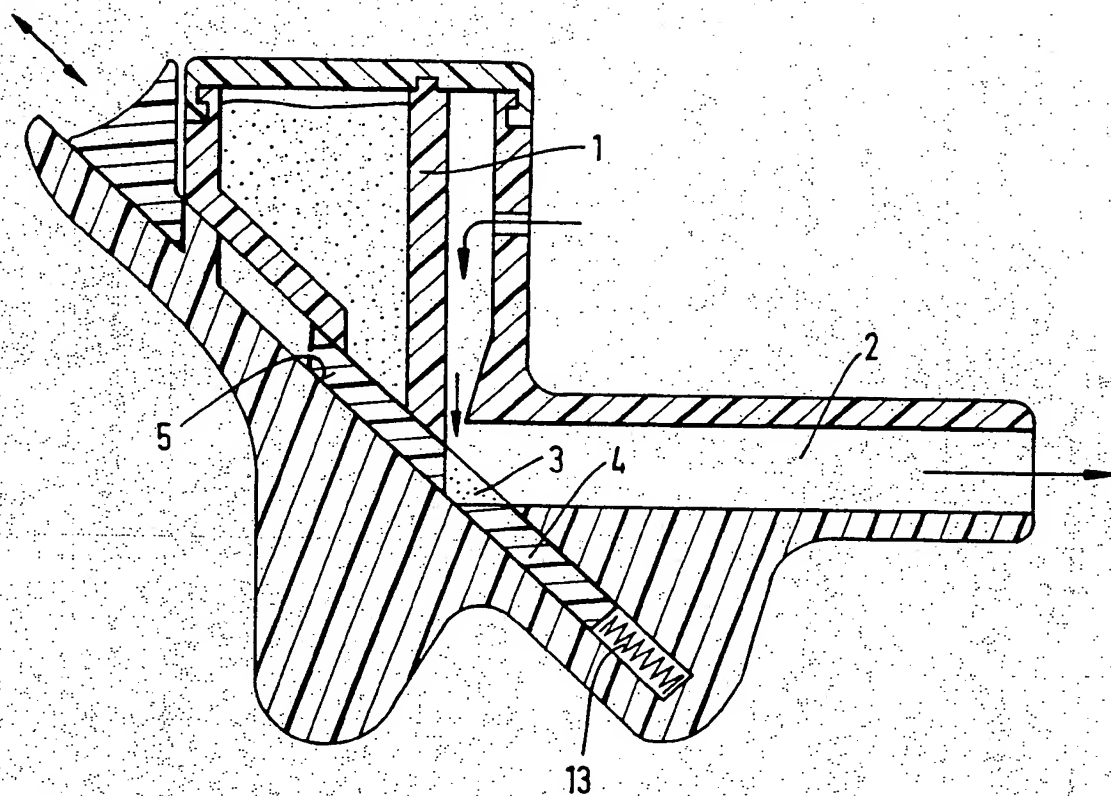


Fig. 4

INTERNATIONAL SEARCH REPORT

International Application No.

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A61M15/00

According to International Patent Classification (IPC) or to both national classification and IPC

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO,A,93 16748 (INNOVATA BIOMED LTD) 2 September 1993 see abstract; figures 1-8 see page 22, line 6 - page 25, line 10 see page 25, line 30 - line 34 ---	1-5
X	US,A,4 274 403 (STRUVE ROGER L) 23 June 1981 see abstract; figures 3-5 see column 3, line 3 - column 5, line 28 see column 6, line 3 - line 33 ---	1,2,4,6
X	WO,A,93 03782 (BON F DEL ;BON LUIGI DEL (CH)) 4 March 1993 see abstract; figures 23-25 Y see page 11, line 22 - page 12, line 14 see page 26, line 20 - line 31 see page 28, line 7 - line 22 ---	1,2,4,5 6,7
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Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US,A,2 587 215 (FRANCK P. PRIESTLY) 26 February 1952 see column 3, line 14 - column 4, line 51; figures 1-11	6,7
A	see column 4, line 55 - column 5, line 27 ---	1-5
A	WO,A,90 07351 (SCHENK HANS GERNOT ;PEDERSEN SOEREN (DK)) 12 July 1990 -----	

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